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PATENT APPLICATION

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FOR: ROLLER BOTTLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This invention relates to a cap for closure of the liquid opening of a container, and more particularly to a two-piece cap for a roller bottle.

2. Description of Related Art

[0002] One type of container commonly used in the laboratory for culturing of cells is known as a "roller bottle". Roller bottles are generally cylindrically shaped and are adapted to rotate about their axes. The internal surfaces of such roller bottles are for providing active surfaces for cells. Following introduction of a liquid growth medium into the liquid opening of the roller bottle, the bottle is capped. The subsequent rotating movement of the bottle keeps the internal surfaces wetted with a liquid medium, thereby encouraging the growth of cells. Rotating rollers of an appropriate apparatus are employed to rotate these roller bottles.

[0003] Current caps used to seal the liquid opening of roller bottles, as well as flasks and centrifugal tubes are screw-on caps of a one-piece design. The mechanical advantage of a screw-type threaded cap is translated to an axial force, wedging the sealing mechanism into the inner rim of the container, forming a tight seal due to the interference fit between the sealing mechanism and the container rim. With the current caps, some of the torque required to seal and unseal the bottle is generated by the friction created when the sealing mechanism rubs against the container rim as it rotates with the cap during assembly and disassembly. The elimination or reduction of this friction translates to a lower torque required to attach and detach the cap from the container.

[0004] A problem associated with the one-piece design of the cap has been the large amount of torque required to remove the cap from bottles once the seal-area has become crusted with dried media. In particular, the roller bottle user must apply an especially high amount of torque to remove caps that are stuck to the bottle because the media contained within the bottle has dried between the cap and the bottle rim, acting as an adhesive. To remove a one-piece cap, the user must rotate the cap and grind the dried media against the sealing surface as the sealing surface rotates against the inner bottle rim.

[0005] A need exists, therefore, for an improved cap for roller bottles, flasks, centrifugal tubes and other containers where the ability of the user to attach and detach the cap using a low amount of torque is of importance. In particular, it would be advantageous to provide a cap with a sealing mechanism that was free to rotate about the axis of the cap, so that rather than rubbing against the inner rim of the bottle as the cap rotates, the sealing mechanism instead moves up or down as the cap moves up or down.

SUMMARY OF THE INVENTION

[0006] The present invention provides a cap assembly for closing an opening in a neck portion of a container. The cap assembly includes a cap body having a top wall and a depending annular skirt for screw attachment to the neck portion of the container. A plug seal is attachable to an underside of the top wall of the cap. The plug seal and the cap are relatively rotatably coupled for independent rotation of the cap body with respect to the plug seal upon attachment and removal of the cap assembly from the neck portion of the container.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1A is top perspective view of the two-piece cap assembly of the present invention.

[0008] FIG. 1B is a bottom perspective view of the cap assembly of FIG. 1A.

[0009] FIG. 2A is a top perspective view of the cap body of the inventive cap assembly.

[0010] FIG. 2B is bottom perspective view of the cap body of FIG. 2A.

[0011] FIG. 3A is a top perspective view of the plug seal component of the inventive cap assembly.

[0012] FIG. 3B is a bottom perspective view of the plug seal of FIG. 3A.

[0013] FIG. 4 is a cross-sectional showing of the cap assembly of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Referring now to the drawings, in which like reference characters refer to like parts throughout, FIGS. 1A and 1B show a cap assembly for closing the liquid opening in a neck portion of a container in accordance with the present invention. In particular, FIGS. 1A and 1B show a roller bottle cap assembly **10**. As can be seen, cap assembly **10** includes a cap body **12** having a top wall **14** and a depending annular skirt **16** for screw attachment to the neck portion of a roller bottle, and further includes plug seal **18** which is attachable to the underside **20** of cap body **12**. Plug seal **18** and cap body **12** are relatively rotatably coupled for independent rotation of the cap body **12** with respect to plug seal **18** upon attachment and removal of the cap assembly **10** from the neck portion of the roller bottle or other container.

[0015] In contrast to prior art one-piece caps, with the two-piece cap assembly of the present invention, some of the torque required to attach and detach the cap body from the neck of a container is eliminated because the sealing mechanism does not have to rotate as the cap is rotated during attachment and detachment of the cap body. In particular, plug seal **18** is free to rotate about cap body axis **24**, so that rather than rubbing against the inner rim of the bottle as the cap body rotates, it simply moves up or down as the cap body moves up or down.

[0016] With reference now to FIGS. 1A and 2A, in one embodiment, the cap body **12** of the inventive cap assembly includes a central orifice **22** for accommodating plug seal component **18**. The orifice **22** may be stepped to help provide a snap-fit with plug seal **18**.

[0017] As shown in FIG. 1A and B and FIG. 2A and B annular skirt **16** of cap body **12** includes an inner wall **30** and an outer wall **32**. The inner wall **30** may include threads **34** for removably attaching the cap assembly **10** from the neck portion of the container. As shown in FIGS. 2A and 2B, outer wall **32** of annual skirt **16** may include vertical ribs **36** to improve the user's grip during attachment and detachment of the cap. Inner wall **30** may include a locking arrangement **38**, as shown in FIG. 2B, for holding the cap assembly in a locked open position on the roller bottle for maintaining the roller bottle open to the environment surrounding it. With further reference to FIG. 2B, the underside of top wall **14** of cap body **12** preferably includes two projecting rings **39** which reduce surface contact between cap body **12** and plug seal **18**. Desirably, such rings are integrally formed with the cap.

[0018] Referring now to FIGS. 1A and 3A, top surface **26** of plug seal **18** includes flanges **28** to provide a snap-fit attachment to the underside of the cap body. Flanges **28** may be integrally formed with top surface **26** of plug seal **18** and are configured in an annular ring for association with orifice **22**. As needed, the orifice may be stepped to help provide the snap-fit, as described above.

[0019] As shown in FIGS. 3A and 4, top surface **26** of plug seal component **18** cap assembly **10** includes an annular groove **40** to help further provide a snap-fit attachment with cap body **12**. In particular, as shown in the cross-sectional view of FIG. 4, top wall **14** of cap body **12** may include depending annular projections **42** spaced radially from depending annual skirt **16** to help provide a snap-fit with the annular groove **40** of plug seal **18**.

[0020] Referring now to FIG. 3B, in one embodiment, bottom surface **44** of plug seal component **18** includes tabs **46** in a spaced annular arrangement for insertion of a device (not shown) to form a vented cap assembly. For example, the tabs **46** may permit attachment of a gas-permeable membrane to permit free passage of oxygen and carbon dioxide while preventing passage of

bacteria and fungi into the roller bottle. Suitable gas-permeable membranes can be made of materials such as polyethylene, polycarbonate, acrylic co-polymers and polytetrafluoroethylene.

[0021] In viewing conditions for producing cap assemblies in accordance with the invention, a variety of thermoplastic materials may be utilized, including, for example, polystyrene, polyethylene terephthalate, the polyolefins and polyvinylchloride.

[0022] In contrast to prior art caps, the sealing mechanism of the present invention rotates independently about the axis of the cap. The sealing mechanism does not rotate as the cap rotates, thereby eliminating the friction normally occurring when the sealing mechanism rubs against the container rim as it rotates with the cap. Therefore, lower torque is required to attach and detach the cap from the container. This represents a significant advantage in situations where media contained within the roller bottle dries against the cap and bottle rim, acting as an adhesive. With prior art one-piece roller bottle caps, the user was required to rotate the cap and grind the dried media against the sealing surface as the sealing surface rotated against the inner bottle rim. However, with the two-piece design, the sealing surface is lifted free of the crusted media at the bottle rim, rather than grinding against it as the cap rotates.

[0023] Whereas the cap assembly of the invention is particularly useful for closing the liquid opening of cell culture vessels, such as roller bottles and flasks, it is further anticipated that the inventive cap assembly would be useful for closure of an opening in a neck portion of a centrifuge tube or bottle, where it is important that the user not be required to apply a large amount of torque to attach and detach the cap. For example, following centrifugation, there may be discrete layers of separated components in the liquid medium which have less chance of intermixing in situations where the user applies a low amount of torque when detaching the cap and retrieving the separated components from the centrifuge tube or bottle.